



AN OPEN AND CLOSED METAL VESSEL WITH WHICH TO HOLD METALS HOT
AND TO MELT THEM, AND FOR TRANSPORTING SAID LIQUID METALS

BACKGROUND AND SUMMARY

[0001] The present invention relates to an open and closed metal receiving vessel of the kind ~~defined in the preamble of claim 1~~ serving to hold metals hot and to melt them, further to transporting such liquid metals.

[0002] Displaceable as well as fixed-shape crucibles are used to hold metals hot and to melt them.

[0003] Displaceable crucibles ~~illustratively~~ are typically made of clay-graphite, silicon carbide, cast iron, cast steel or metal plate, depending on casting materials to be held hot or be molten. They are used in hot holding furnaces or in melting furnaces. Heating can be carried out by means of electrical resistors, induction or gas. Heat transfer to the liquid or solid metal in the crucible through the furnace space or, in the event induction is used, directly through the crucible wall, will entail substantial wear due to thermal, mechanical and chemical stresses on the crucibles being used. Moreover, where electrical resistance or gas heating is used, large energy consumption is required to heat the furnace space and the crucible, as well as being incurred by the heat dissipation taking place at the refractory furnace lining. Illustratively the German patent document 29 17 577 A1 discloses a heat-resistant collecting vessel for the leakage melt and switch elements detecting said melt, while the European patent document 0 895 490 B1 and the German patent document 198 02 342

describe a crucible furnace for low-pressure casting or for filling the pressurized chamber of a horizontal and vertical cold-chamber of a pressure die casting machine.

[0004] Permanently integrated crucibles constitute a permanent part of the furnace. Typically they consist of chamotte brick masonry with a stamped or cast refractory lining. Because of the masonry thickness, the liquid-melting heating in the furnace is carried out inductively. This design incurs the substantial drawback that the induction channel--in particular as regards aluminum alloys--depending on flow rate of the metal, may already be clogged after only about 2 weeks because of the adhesion of the oxides and nitrides and thus shall block said flow. In order to (re)open the said induction channel, most of the time the casting furnace must be exchanged, the residual melt must be removed, and said channel must be pried open using a compressed air hammer. Also the furnace outside surface temperatures run to 70 to 100°C while being as high as 120°C in the region of the induction channel. This closed furnace system is used especially for low pressure casting.

[0005] The objective of the present invention is to avoid ~~said~~ known drawbacks by ~~proposing~~ providing an open and closed metal receiving vessel to hold hot, and to melt metals and to transport ~~said~~ liquefied metals, ~~said~~ the container being free from a crucible whether, under the conventional definitions, ~~said~~ the crucible either is displaceable or permanently integrated.

[0006] To attain this goal, the open and closed metal receiving vessel is constituted by a housing at the inside of which thermally insulating materials subtend an open or closed cavity lined with a textile 3D-surface structure, ~~the closed metal vessel being fitted with a~~

~~displaceable riser pipe~~. Advantageous embodiment modes and further developments of the invention are stated in the dependent claims.

~~[0001] When, in its open mode, the open and closed metal vessel of the present invention may serve as a hot holding, scooping and melting furnace, whereas in its closed mode, it may serve as a hot holding furnace, a low pressure casting furnace, a low pressure metal transporting furnace and as a liquid metal, transporting container.~~

[0007] The open and closed metal receiving vessel of the present invention comprises an integral 3D-surface structure lining which covers in seamless manner the open and closed cavity of the metal receiving vessel to receive the liquid or solid metal and it is further fitted with discharge channels and covering surfaces. This goal is attained by the high flexibility of ~~said the~~ structure and its versatility in assuming many geometric and spatial configurations. This integral, textile 3D-surface structure may be used as a single layer or a multi-layer to line and cover cavities and surfaces. By coating the single or multilayer surfaces of ~~said the~~ 3D-surface structure, and depending on the requirements set on the said liquid or solid metals, the thermal, chemical as well as mechanical properties of said metals may be additionally enhanced. According to a further, advantageous embodiment, the thermally insulating materials of the metal receiving vessel can be made with seam and/or seamless.

[0008] The textile surface structure consists of textured ceramic fibers having high shock and thermal strength, as well as high coefficient of elasticity. This involves a considerable increase in the utilization times for metal vessels in casting operations. The low thermal conductivity and accumulation heat of the ceramic fibers allow a quick heating and cooling with a minimum of energy loss. A further, considerable advantage is the low weight

of the textile surface structure and of the thermally insulating materials. Thanks to this arrangement, the costs deriving from purchase of the metal vessels and from their use in casting operations can be strongly reduced.~~In a further advantageous embodiment of the present invention, the thermally insulating material enclosing said textile structure's inside and outside surfaces is designed to be a seamlessly upwardly open insulation housing.~~

[0009] In order to preclude chemical and/or electrical reactions, the heater elements inserted into the liquid metal(s) are clad by appropriate protective substances. ~~Said~~The heater elements are configured underneath the said textile structure and are protected by a thin and exchangeable plate against leakages of liquid metals.

~~[0009]~~[0010] The open and closed metal receiving vessel according to embodiments can be used as waiting furnace for maintenance of melting temperature, the closed arrangement being suitable as furnace for maintenance of the temperature, low pressure casting furnace, low pressure transport furnace and as transport vessel for liquid metals. The materials for the textured textile surface structure preferably include ceramic fibers, but could include glass foam.

~~[0010]~~[0011] The integral, displaceable furnace riser pipe affixed to the closed metal receiving vessel is made to pass through, and be centered relative to, a bush. Said furnace riser pipe is displaceably connected to a drive system which implements the openings and closings related to continuously filling with liquid metals both metallic and non-metallic casting and furthermore to filling pressure chambers molds with said liquid metal(s).

~~[0011]~~[0012] In order to assure the greatest possible safety of operation, the closed metal receiving vessel shall be additionally placed within a sealable single or multiple container when liquid metal must be transported.

~~[0012]~~[0013] ~~Claim 5 cites~~ Embodiments employ wear-resistant, flexible materials ~~to be used for the textile, 3D-surface structure, whereas claim 7 lists~~ such as ceramic fibers, which are effective thermally insulating materials. ~~Additionally, embodiments and claim 8 cites use~~ protective substances ~~for on~~ the heater elements inserted into the liquid metal and configured underneath the textile 3D-surface structure. The just above cited advantages as well as further ones are discussed below in relation to the preferred embodiment of the present invention and in relation the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

~~[0013]~~[0014] FIG. 1 is a cross-section of an open metal receiving vessel of the invention,

~~[0014]~~[0015] FIG. 2 is a cross-section of a closed metal receiving vessel of the invention fitted with a displaceable riser pipe,

~~[0015]~~[0016] FIG. 3 is a cross-section of an open metal receiving vessel of the invention used to melt metals, and

~~[0016]~~[0017] FIG. 4 is a cross-section of a closed metal receiving vessel of the invention used for transporting liquid metal.

DESCRIPTION

~~[0017]~~[0018] The open metal ~~receiving vessel~~ of FIG. 1 shows an aperture 12 which passes through the textile 3D-surface structure 4 and is used to fill the cavity 11 with liquid and solid metals and also to remove liquid metal for casting. The heating to hold hot and to melt liquid and solid metals in this embodiment can be implemented by heater elements 6, 7 8 or by induction 9. Accordingly the open ~~metal vessel~~metal receiving vessel 1a may serve as a hot-holding, ladling and melting furnace for casting operations.

~~[0018]~~[0019] FIG. 3 shows another open ~~metal vessel~~metal receiving vessel 1c to melt metals by means of an inductive heater 10 and fitted with a discharge channel 13 for the liquid metal.

~~[0019]~~[0020] The closed ~~metal vessel~~metal receiving vessel 1b of FIG. 2 has been filled with a liquid metal 18 in its cavity 11 and comprises both a hermetically sealing furnace cover 16 which, jointly with said container's thermally insulating lining 3c and the surface of the liquid metal, subtends a gassing space 17, and the furnace riser pipe 20 connected to the control system 23 assuring the vertical opening and closing steps between said pipe and the casting mold 22. The bush 21 mounted on the furnace cover 16 guides and centers the displaceable furnace riser pipe 20. This advantageous design allows rapidly and simply exchanging the furnace(s) used in casting. In this instance the liquid metal also may be heated by the heater elements 6, 7, 8 or by induction 9. In this manner the closed ~~metal vessel~~metal receiving vessel 1b may serve as a low pressure casting furnace or a low-pressure metal transporting furnace to fill casting molds or pressure chambers for pressurized casting and also to hold metals hot in casting operation.

~~[0020]~~[0021] FIG. 4 shows another closed ~~metal vessel~~metal receiving vessel 1d for transporting liquid metals in a closable single or multi-container 28. To preclude the liquid metal from sloshing while being transported, the thermally insulating material 3f lining the inside space of the transport container's cover 25 comprises a cone dipping into the liquid metal. With this design the metal container 1d serves directly as a hot-holding furnace for metal buffering in casting plants and furthermore--on account of said exchanging or removing said furnace cover--as a hot-holding, ladling, melting furnace, a low-pressure casting furnace and a low-pressure metal transporting furnace, the heating of the liquid metals optionally being implemented by insertable heater elements 6, 7 or by stationary, pre-installed heater elements 8 or by induction 9.

~~[0021]~~[0022] The inventive open and closed ~~metal vessel~~metal receiving vessel 1a, 1b, 1c, 1d may be manufactured in all possible geometric shapes, the outer casing 2 subtending the inner space in turn subtending by means of the thermally insulating materials 3, 3a, 3b, 3c, 3f and by the textile 3D-surface structure 4, an open and closed cavity 11 receiving the liquid or solid metal which it shall hold hot or implement melting it or it shall transport the liquid metal.

~~[0022]~~[0023] The high flexibility ~~and tear-resistance~~ of the textile 3D-surface structure 4 allows ~~seamlessly~~ lining the cavity 11, the discharge channel 13 and the cover surfaces 2', 3', 3a', where movable pins 14 or fixed pins 15 affix the textile 3D-surface structure 4 in its position. Because the liquid metal may be drained from the open ~~metal vessel~~metal receiving vessel 1a, 1c or from the ~~metal vessel~~metal receiving vessel 1b, 1d to be opened, exchanging the textile 3D-surface structure 4 can be carried out in a brief time. Another advantage

regarding the textile 3D-surface structure 4 is its collapsibility and its low weight, said features being substantial advantages as regards their storage and transportation. Because of the high thermal strength of the textile 3D-surface structure 4, pre-warming time intervals or slow heating rates of the open and closed metal container 1a, 1b, 1c, 1d are not required.

~~[0023]~~[0024] In order to further reduce heat losses due to convection, the invention comprises the upwardly open insulation housing which is made of seamless, thermally insulating materials 3, 3b, the material 3 consisting of a cast glass foam and the thermal insulation 3b is made of fiber ceramics withstanding high compressive loads. These features and the optimal heat barrier represented by the open and closed melt vessels 1a, 1b, 1c, 1d allow mounting the heater elements 6, 7, 8 directly in or at the cavity 11, the heater elements 8 being protected against leakage of metal liquid by a thin and exchangeable plate 3d. On account of this direct and also indirect transfer of heat to hold hot and melt metals, it is possible to preclude metals from overheating and thus exclude the otherwise entailed adverse chemical reactions as well as increased gas absorption.

~~[0024]~~[0025] ~~In order to preclude transported liquid metal from sloshing, the inside space of the cover 25 of the closed metal container 1d is lined with a conical heat insulating material 3f dipping into the liquid metal. Be it further borne in mind that details relating to design which may entirely differ from those disclosed above may shall fall within the scope of the present invention.~~

~~[0025]~~[0026] It will be appreciated that various of the above-disclosed and other features and functions, or alternatives thereof, may be desirably combined into many other different systems or applications. Also that various presently unforeseen or unanticipated alternatives,

modifications, variations or improvements therein may be subsequently made by those skilled in the art which are also intended to be encompassed by the following claims.

WHAT IS CLAIMED IS: